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ARMORED FAMILY OF VEHICLES (AFV)
COMMAND, CONTROL, COMMUNICATIONS, INTELLIGENCE (C3I)
ARCHITECTURE SUMMARY
AUGUST 30, 1988

TRADOC AFV Proponency Office (AFV-PO)
ATZL-CAB, Fort Leavenworth, Kansas 66027-5300
(913) 684-3715 or Autocon 552-3716

AMC AFV Integration Group
AMCSP-AFV, 5001 Eisenhower Avenue
Alexandria, Virginia 22333-0001
(202) 274-1965 or Autocon 284-1966

DA Armored Family of Vehicles Task Force
DAMO-AFV-C, Fort Eustis, Virginia 23604-5597
(804) 878-1465/1466 or Autocon 927-1465/1466

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AFV C3I ARCHITECTURE SUMMARY

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1. SCOPE. This summary describes the Armored Family of Vehicles (AFV, CARDS number 01009P) Command, Control, Communications and Intelligence (C3I) architecture functions and characteristics. The architecture is developed in two distinct parts - the Battalion and Below Command and Control (B2C2) System and the Vehicle Control and Operating System (VCOS). When B2C2 and VCOS are combined they result in the battalion level AFV C3I Architecture.

2. PURPOSE. This document proposes an initial set of requirements for an integrated C3I architecture, which considers AFV as an integrated element of overall force effectiveness. This proposed set of requirements should be inserted into the AFV concept formulation and requirements development processes for evaluation and refinement.

3. GOAL AND INTENT OF AFV C3I.

A. The AFV Architecture builds on the established goals of the Army Tactical Command and Control System (ATCCS) -- a combat effective C3I architecture from the forward line of troops through and beyond the division headquarters. The concept accelerates planned vertical integration within each mission area, expands it horizontally at battalion and below levels, maximizes commonality, and captures salient AFV subsystem characteristics to achieve task organized battalion and below C3I.

B. The intent is to provide the chain of command and staff a time saving horizontal and vertical command and control support system with structured flexibility in a dynamic battlefield environment. Of equal importance is the goal of achieving maximum integrated support for the soldier to reduce his C3I and vehicle work loads -- to allow the soldier to focus on the battle and not vehicle equipment operation.

4. MISSION.

A. The B2C2 system is to provide the battalion commander, chain of command, and staff with a comprehensive picture of the battlefield and the capability to assure appropriate decision implementation. The B2C2 system will provide tailored support in fighting the force at squad, platoon, company, troop, battery, and battalion or squadron levels consistent with unit intent and information needs while maintaining compatibility and interface within the Army Tactical Command and Control System.

B. The VCOS mission is to acquire, integrate, and present, in a readily understood manner, information and control functions critical for the effective employment and operation of the vehicle. VCOS assists the soldier to fight the vehicle with information collection, retention, organization, and communication control assistance. The VCOS support mission is to provide collected information to the organization command and control system.

5. SYSTEM ENVIRONMENT. The architecture is envisioned to support the soldier and chain of command functions listed below. These are generic activities

which occur with or without AFV. AFV plans are to achieve to maximum cost effective support in these generic areas.

B2C2 Supported	Activity or Function Support	VCOS Supported
<hr/> Plan, Prepare and Monitor Unit OPORD Execution Change Guidance based on Situation Maintain Operational Status and C2 Info Pass Info Related to Cmd and Control Determine Mission Readiness Portray Friendly and Enemy Information Know Unit Locations, Present Battlefield Geometry Conduct Fire Planning and Requested Support Send or Receive Notification of Threat Air Attack Expedite Mission Critical Logistic Requests Notification of NBC, Direct Energy (DE) Attack Determine Air Defense and Fire Support Effectiveness Obtain Personnel and Logistics Support Know Organization Vehicle, Supply and Personnel Status Determine Combat Support Availability Determine NBC and DE Protection Readiness Status Report Incoming Fires Accept Reports of Activity or Situation Changes Develop Target Information and Threat Battle Plan		<hr/> Conduct Training Crew or Staff Internal Commo Control Vehicle and Integrate Info Survive on the battlefield Maintain Power for Operations Acquire, Designate, Shoot Targets Interaction with other crews/staffs Pass & Coord Info within Vehicle Perform Land Navigation Monitor and Maintain Vehicle Opns Diagnostics/Prognostics Plan or Execute Command and Control Conduct 24 hour Operations Maintain Vert. and Horizontal Commo Conduct of Designated Mission Conduct Supply or Logistics Actions Operate Vehicle Equipment

6. SYSTEM SUPPORT FUNCTIONS. The functions are summarized by the system components listed below. These components represent the maximum functionality that may reside at battalion level. Reduced functional levels are expected at squad, section or team level. The components will be modular to ensure they are tailorable to the chain of command, staff, and soldiers supported.

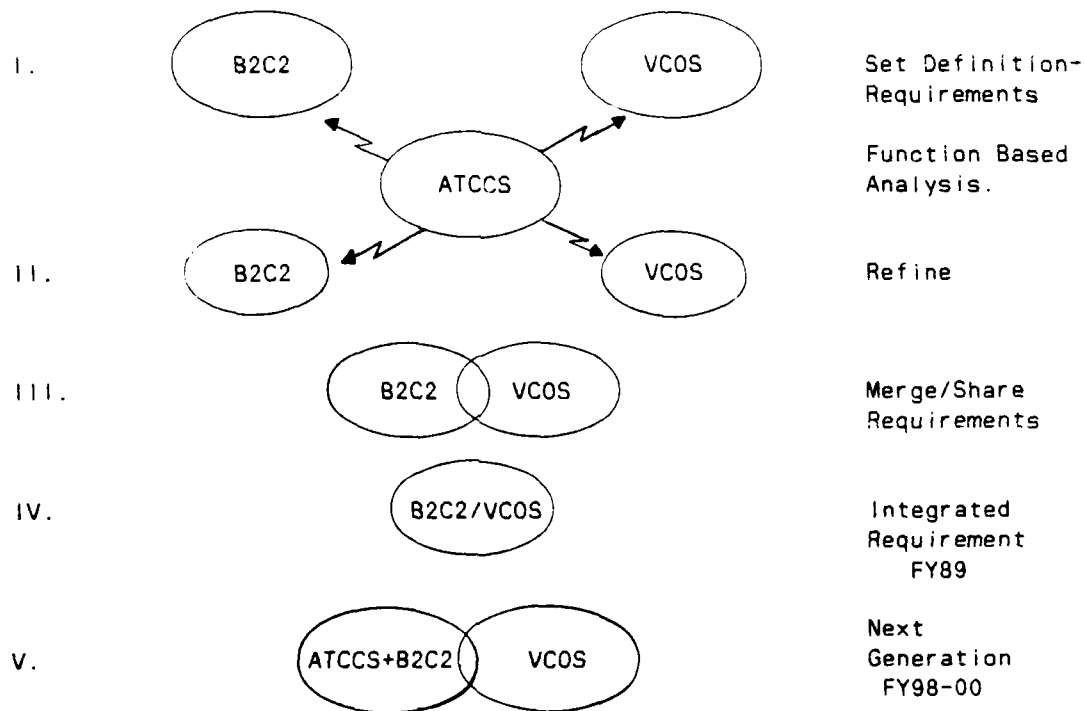
- A. B2C2. The B2C2 support components and objectives are to provide:
- o Tactical Command and Control (C2), to influence the battle, facilitate the C2 and maneuver of the battalion force,
 - o Tactical [C2] Feedback, to provide supporting mobility and survivability information correlation assistance,
 - o Functional C2, to provide mission area support in priority fire support, air defense and critical combat service support,
 - o Functional Information and Feedback, provides routine multi-mission (CSS, AD, FS) support and status,
 - o Reconnaissance Surveillance and Target Acquisition (RSTA) and Intelligence, to assist in situation, and target information collection, and
 - o Intelligence [RSTA] Feedback, is envisioned to provide the evaluated situation and target development dissemination.

B. VCOS. The generic vehicle and soldier related activities are to receive support from the following reconfigurable VCOS components. These integrated components represent maximum capabilities.

VCOS Support Components

- | | |
|----------------------------|----------------------------|
| o Embedded Training | o Fire & Weapon Control |
| o Position & Navigation | o Automotive Management |
| o Intercom | o ATCCS/B2C2 Interface |
| o Fighting Station | o Environment Control |
| o Continuous Power | o Communications |
| o Vehicle Defense | o Mission Support |
| o External Port/Connection | o Combat Service Support |
| o Target Acq & Recog | o Information Distribution |

7. REQUIREMENTS DEVELOPMENT APPROACH. The approach is to utilize the ATCCS functional baseline to refine B2C2 and VCOS during the AFV Concept Exploration Phase.



Operational Definition for the AFV C3I Architecture

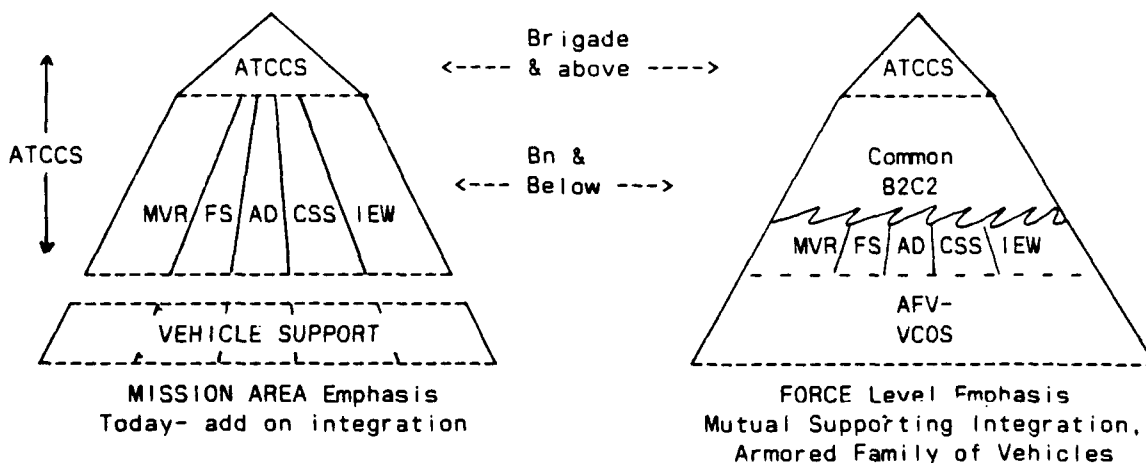
The AFV supported force must have in place a horizontal and vertical C3I system that balances manual and automatic workloads to achieve optimal warfighting support for the chain of command. ATCCS will continue to evolve and top feed information to the battalion system. Horizontal information sharing will occur with ATCCS subordinate systems, adjacent unit B2C2, or organic staff elements with B2C2 modules (or components). Bottom up information flow is supported by the VCOS B2C2/ATCCS module. As C3I and vehicle control requirements mature, the most reliable, efficient, and cost effective means of voice/data communications and manual/automatic information processing must be developed.

8. CLOSING REMARKS.

A. The mission of B2C2 and VCOS is to assist the chain of command to fight the force and provide maximum cost effective support to the soldier in fighting the vehicle. Based on the goals of AFV design, the set of modular requirements common to the force can be tailored by selecting the functions from the VCOS and B2C2 battalion level sets. This tailoring enables maximum integrated support based on unit and soldier missions.

VCOS - FIGHT THE VEHICLE Help the Soldier
 B2C2 - FIGHT AND SUPPORT THE FORCE Assist the Chain of Command
 ATCCS - FIGHT AND SUPPORT THE ENTIRE FORCE . Mission Area Support & Control

B. The AFV approach for lower echelon integrated C3I is to take the objective ATCCS architecture one step further toward comprehensive integration. The inclusion of B2C2 within the ATCCS architecture supports extended ATCCS. Heretofore, ATCCS battalion and below plans have generally been developed independently, within a combat mission area, or with a targeted product improved combat system in mind. The potential advances in command and control have not been considered in terms of a combat force armed with AFV.



C. The evolving ALB-Future doctrine requires synchronized C3I for the deep, rear and close operations. AFV subsystems will perform mission roles in each battle area. The anticipated benefits of a common lower echelon C3I are: support for combat (regardless of primary mission), interoperability among task organized units, two dimension communications - voice for command & data for supporting information, reduced work effort (grease pencil backup), and time saved.

9. POINTS OF CONTACT. Major Jones (TRADOC AFV Proponency Office) AV 552-3715, Mr. Dudley (CACDA, C3I) AV 552-4786, Captain Mingilton or Major Moore (AMC AFV Integration Group) AV 284-1965, or Major Buckstad (AFV Task Force, CD) AV 927-1465.

OPERATIONAL DEFINITION for the AFV C3I ARCHITECTURE

1. SCOPE. This summary describes the Armored Family of Vehicles (AFV, CARDS number 01009P) Command, Control, Communications and Intelligence (C3I) architecture functions and characteristics. The architecture is developed in two distinct parts - the Battalion and Below Command and Control System (B2C2) and the Vehicle Control and Operating System (VCOS). When B2C2 and VCOS are combined they result in the battalion level C3I functional architecture.

2. PURPOSE. The purpose of this document is to propose an initial set of requirements for a battalion and below C3I architecture to support the concept formulation and requirements development processes. The intent of the architecture is to provide the battalion commander, staff, and subordinate chain of command a time saving horizontal and vertical command and control support system with structured flexibility in a dynamic battlefield environment. The AFV C3I Architecture depicts the architecture from the squad through the battalion headquarters elements.

3. C3I GOAL.

A. AFV Architecture builds on the established goals of the Army Tactical Command and Control System (ATCCS) - a combat effective C3I architecture from the forward line of troops through corps. The AFV concept accelerates planned [ATCCS] vertical integration within each mission area and expands horizontal integration at battalion and below levels to achieve task organized battalion and below force level control. B2C2 is expected to achieve this goal with integrated VCOS support.

B. Of equal importance is the goal of achieving maximum integrated support for the soldier to reduce his C3I and vehicle workloads, improve efficiency and increase reliability -- to allow the soldier to focus on the battle and not vehicle equipment operation. This is the VCOS goal.

4. ASSUMPTIONS AND DEFINITION APPROACH.

A. An underlying assumption is the need to define a candidate set of C3I functions for automatic support and vehicle embedded support functions for the soldier without premature materiel constraints. ATCCS developments will continue and serve as the functional baseline for analysis and AFV C3I developments. B2C2 and VCOS will enhance command and control of the unit and vehicle and serve mutually supportive roles. Voice communications will remain a principle C2 tool. Data communications will provide real or near real time distribution of C2 supporting information.

B. The architecture has two distinct parts: B2C2 and VCOS. These parts establish a logical separation between unit command and control and internal vehicle control. This separation allows requirement development decisions and refinements to be made for each area. Eventually the requirements must be

Operational Definition for the AFV C3I Architecture

merged during the requirements development process as it is envisioned that hardware (to include communications) or software functionality may be shared to reduce cost.

5. MISSION DEFINITION. The Battalion and Below Command and Control (B2C2) system comprises the C3I functions required to fight the battalion force. The Vehicle Control and Operating System (VCOS) is the internal system to orchestrate the vehicle function and provides operational support for B2C2.

A. B2C2 Primary Missions.

1) The mission of the B2C2 system is to provide the battalion commander and chain of command with a comprehensive picture of the battlefield and the capability to assure appropriate decision implementation. Both are based on the information available within their sphere of influence and areas of responsibility. The B2C2 system will provide tailored support in fighting the force at team, section, squad, platoon, company, battery, troop, and battalion or squadron levels consistent with the unit commanders intent and information needs while maintaining compatibility and interface within the Army Tactical Command and Control System.

Plan, Prepare and Monitor Unit Operations Order Execution
Change Guidance based on Situation
Pass Information Related to Command and Control
Portray Friendly and Enemy Information and Geographical Relationships
Maintain Operational Status and C2 Info, Determine Mission Readiness
Display Unit Locations, Present Battlefield Graphics or Geometry
Conduct Fire Planning and Requested Support
Send or Receive Notification of Threat Air Attack
Expedite Mission Critical Logistic Requests
Notification of Nuc, Chem, Bio (NBC), Direct Energy (DE) Attack
Determine Air Defense and Fire Support Effectiveness
Obtain Non-critical Personnel and Logistics Support
Obtain and Maintain Supply and Personnel Status
Maintain Organization Vehicle Status
Determine Combat Support Availability
Determine NBC and DE Protection Readiness Status
Report Incoming Fires, Accept Reports of Activity or Situation Changes
Develop Target Information and Threat Battle Plan

B2C2 SUPPORTED COMMAND AND CONTROL GENERIC FUNCTIONS

Operational Definition for the AFV C3I Architecture

B2C2 Primary Missions (continued)

2) The envisioned B2C2 system is planned to support the generic C3I functions listed above. These functions are directly related to the B2C2 subordinate components. The six B2C2 components, support objectives and functions are:

- oo Tactical Command and Control (C2), to influence the battle, facilitate the C2 and maneuver of the battalion force.

-----	-----
Operations Order	Operational Status
Warning/Frag Order	Battlefield Locations
Immediate Information	Mission Capability
Battlefield Geometry	
Tactical C2 Functional Summary	Tactical Information
-----	-----

- oo Tactical [C2] Information Feedback, to provide supporting mobility and survivability feedback and correlation assistance.

- oo Functional C2, to provide mission area support in priority fire support, air defense and critical combat service support.

-----	-----
Air, NBC, DE Attack	FS & AD Mission Results
Immediate CSS	Routine CSS Action & Status
Fire Support	Maintenance Posture
	FS/AD/NBC/DE Posture
Functional [Area] C2	Functional Information
-----	-----

- oo Functional Information and Feedback, provides routine multi-mission (CSS, AD, FS) support and status.

- oo Reconnaissance, Surveillance, and Target Acquisition (RSTA) and Intelligence, to assist in situation and target information collection.

-----	-----
Situation Report	Target Information
Shell Report	Threat Geometry
	Order of Battle
RSTA Intell Summary	Intelligence Feedback
-----	-----

- oo Intelligence [RSTA] Feedback, to provide the evaluated situation and target development dissemination assistance.

Operational Definition for the AFV C3I Architecture

3) A view of the B2C2 architecture is presented after the VCOS summary. It restates the B2C2 components, support objectives, and component functionality. The set of component functions depicted within the architecture reside at battalion. Subsets or extracts of this set must be selected for the lower echelon application. The architecture exemplifies the type of support that must be tailored to and be available to the chain of command.

B. VCOS Primary Missions.

1) The primary mission of the VCOS is to present, in a readily understood manner, information and control functions critical for the effective employment and operation of the vehicle. VCOS assists the soldier to fight the vehicle. The figure below lists soldier generic activities and the planned VCOS support component to be provided to assist the soldier in the execution of those functions with improved speed, accuracy and reliability. The activities or component list represents the master set of highest level functionality. As a reconfigurable system, component subsets can be selected based on the vehicle mission. Without a VCOS like system the soldier is the sole combat integrator of squad/vehicle information -- with VCOS the soldier has help.

Generic Soldier Supported Action	VCOS Planned Support Component
Conduct of Training	Embedded Training
Crew and Staff Internal Communications	Intercom
Control Vehicle and Integrate Information	Fighting Station
Maintain Power for Operations	Continuous Power
Survive on the battlefield	Vehicle Defense
Interact with other crews/staffs	External Port/Connection
Acquire and Designate Targets	Target Acq & Recog
Pass & Coordinate Information within Vehicle	Multiple Bus
Conduct of Fire	Fire & Weapon Control
Perform Land Navigation	Position & Navigation
Vehicle Operations	Automotive Management
Plan or Execute Command and Control	ACCS & B2C2 Interface
Conduct and Support 24 hour Operations	Environment Control
Maintain Vertical and Horizontal Commo	Communications
Conduct of Designated or Special Mission	Mission Support
Supply, Maint, Diag/Prog Functions	Combat Service Support

GENERIC SOLDIER ACTIVITIES AND PLANNED VCOS SUPPORT

Operational Definition for the AFV C3I Architecture

2) The secondary mission is to provide already collected information to the organization command and control system. In this role, VCOS provides the soldier with information collection, retention, organization, and communication support.

C. B2C2 and VCOS Mission Summary. The mission of B2C2 and VCOS is to assist the chain of command to fight the force and provide maximum cost effective support to the soldier in fighting the vehicle. Based on the goals of AFV design, the set of modular requirements common to the force can be tailored to the force by selecting the functions from the VCOS and B2C2 sets. This tailoring enables maximum integrated support based on unit mission and soldier missions.

6. ARCHITECTURE. The architecture diagrams that follow are from a logical point of view and represent the functionality of the VCOS and B2C2 systems respectively. The generic functions listed on the preceding charts can be mapped to these top level schematics.

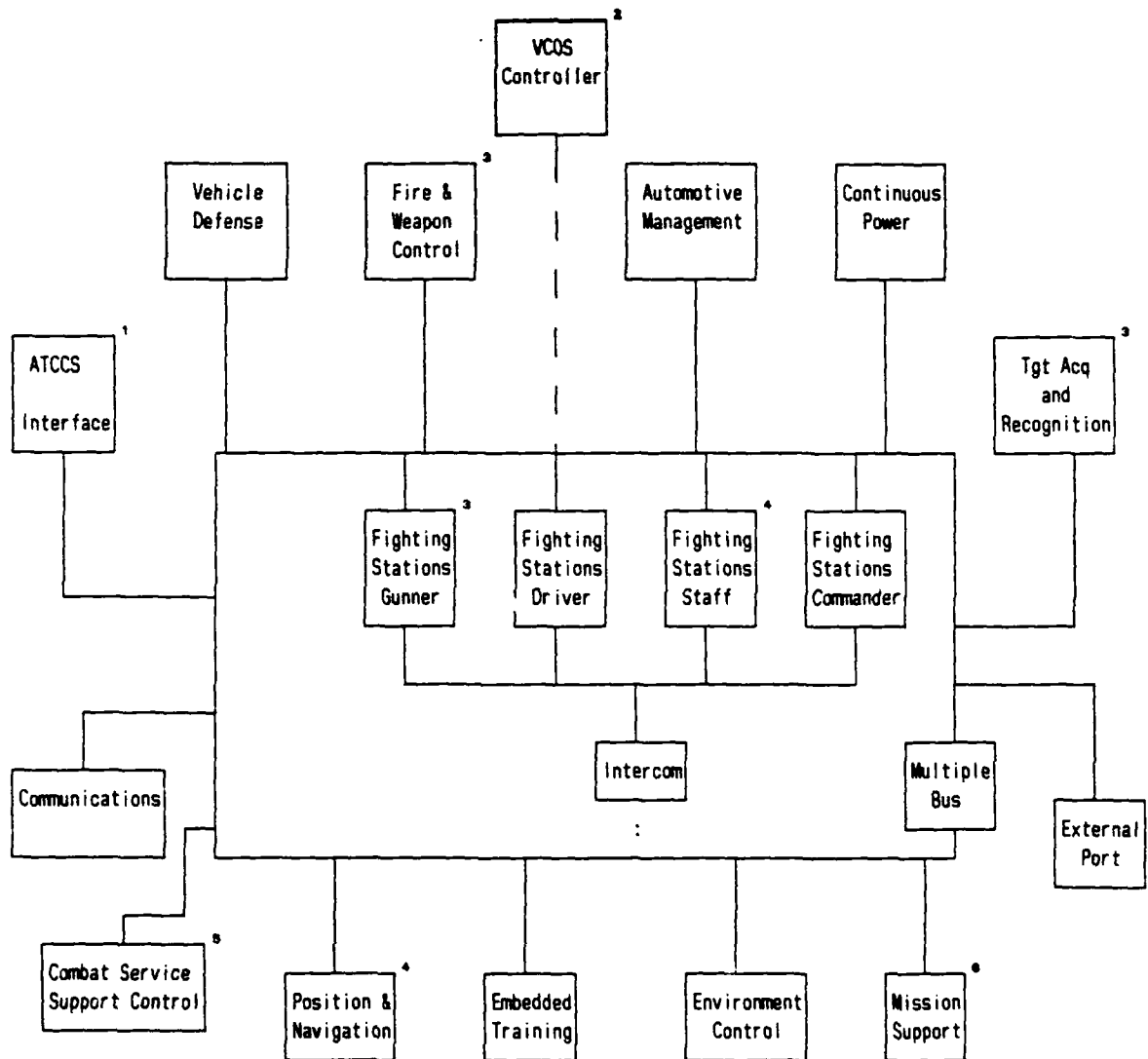
A. VCOS Architecture Overview. The VCOS diagram is a menu (or set) of components representing functions that may be selected for implementation based on mission and battlefield position. The diagram also portrays the most conceptually complex AFV. It represents the maximum levels of interconnection and interface within a vehicle and the reconfiguration capability allowed. This capability allows the commander to reallocate vehicle resources when battle losses occur.

B. B2C2 Architecture Overview. The B2C2 diagram follows the VCOS graphic and also represents the most conceptually complex system. Each B2C2 system module fielded with VCOS must be able to support this architecture. However, the level of implemented (allowed or turned on/off) functions will differ based on the staff or chain of command position. As with VCOS, B2C2 supports reconfiguration or reallocation of resources. The modular B2C2 allows the commander to direct or select the functions required for a particular position in the staff or chain of command. Therefore it is anticipated that B2C2 functions at battalion level will be significantly greater than that of the squad. This is accomplished by down selecting battalion functional capabilities for the echelons below battalion.

Operational Definition for the AFV C3I Architecture

ARCHITECTURE ORGANIZATION

C. Vehicle Control and Operating System (VCOS) Architecture



1= Houses the tailored ATCCS interface.

2= Architecture depicts a fully connected system. AFV modular design allows reconfigurability of components-tailored to mission. It is the set or "menu" of functions required for AFV.

3= Reconfiguration Example: If target acquisition and fire control is manual those components may be removed.

4= Example of component which may be removed due to mission or basis of issue.

5= Includes critical item inventory, diagnostics and evolutionary prognostics.

6= Specific support dependent upon mission.

Operational Definition for the AFV C3I Architecture

1) VCOS Architecture, Component Elements. The table below lists the VCOS components with their elements or parts. The projected utilization column provides a brief battlefield use.

VCOS ¹ COMPONENT	VCOS ELEMENT	PROJECTED UTILIZATION	VCOS ² COMPONENT	VCOS ELEMENT	PROJECTED UTILIZATION
EMBEDDED TRAINING	•Weapon Proficiency •Vehicle Operations •Maintenance •Mission Training •Special Mission •Medical	How To Shoot. Operate. Maintain. Do Your Job. Special Mission. Emergency Assist.	VEHICLE DEFENSE	•Sensor Suite •Controller •Reactive Suite	Detect Threat. Auto/Manual Response. Countermeasures.
INTERCOM	•Commander •Driver/Gunner •Crew •Staff	Internal & External Commo with Noise Reduction.	EXTERNAL PORT	•External Port, Connector	Cmd Post Opns, Platoon Network.
FIGHTING STATION	•Commander •Driver •Staff •Gunner	Control Vehicle. Drive Vehicle. Staff Support. Shoot Control.	TARGET ACQUISITION & RECOGNITION	•Target Acq •Target Recog	Acq & Designate. Classify and Evolve to IFF.
CONTINUOUS POWER	•Automotive •Auxiliary •Battery	Primary Power. Alternate, Pwr. Back Up, Stored.	MULTIPLE BUS	•Power Control •Circulate Info.	Power Components. Information Passing.
AUTOMOTIVE MANAGEMENT	•Driver Control & Feedback	Drive or Operate the Vehicle.	FIRE AND WEAPON CONTROL	•Fire Control •Weapon Control •Ammo Autoloader	Ballistic Data. Orient Weapon. Load Ammunition.
ENVIRONMENT CONTROL	•Threat Protection •Internal Env'ment •Fire Suppression •Combat Lighting	NBC Protection. Temp/Humidity. Detect-Put out Fire. Night Ops.	POSITION/ NAVIGATION	•Pos Control •Nav Control	Location-Direction. On the Move Loc.
MISSION SUPPORT	•As Required	Mission Assistance.	ATCCS/ B2C2 INTERFACE	•B2C2 •ATCCS	House B2C2. House ATCCS Functional, System Module.
VCOS	•Master Controller	Organize Components.	COMMUN- ICATIONS	•Commo Control •Voice Commo •Data Commo	Routing Assistance. Voice-Talk. Data-VCOS or Soldier.
			COMBAT SERVICE SUPPORT	•Built In Test •Diagnostics •Prognostics •Maint Mgmt •Pers readiness. •Config Mgmt.	Organize Dia/Prog. Current Status. Future Status. AutoLogbook. Personnel Status. Detm Vehicle Resources.

^{1,2}: Review VCOS components listed on the previous diagram.

The description of the VCOS Mission Support components or subsystems follow.

Operational Definition for the AFV C3I Architecture

VCOS Architecture

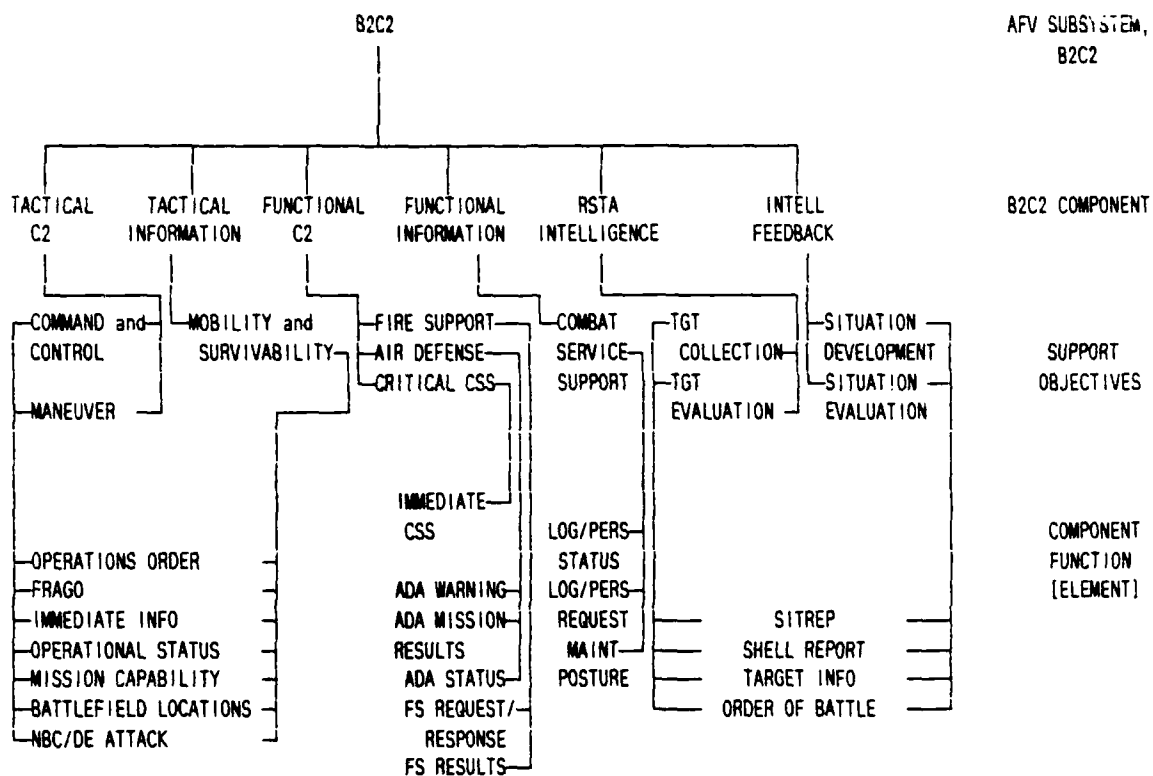
2) VCOS Mission Support, Candidate Subsystems with Limited Distribution. The VCOS candidate mission support subsystems listed below represent sample functions to be considered during AFV development. Each component is projected to have limited distribution on the battlefield and may interconnect or interface with the vehicle architecture.

CANDIDATE SUBSYSTEM	PROJECTED UTILIZATION
Unmanned Aerial Vehicle (UAV)	Airborne UAV Control.
Mine Clearing	Control Mine Clearing Device.
Dozer Blade	Blade Control, Inside Vehicle.
Mine Implantment	Emplace Mines, Assistance
Recovery Control	Assist Vehicle Recovery.
Staff Support	Mission-Area/Responsibility Assist.
Radar	Equipment for Radar Control.
ETAS Support Package	ETAS Special Equipment.
Voice Receiver	Voice Commo - Scanner.
Bridge	Control Bridge Emplacement/Recovery.
ATCCS Equipment	To be determined (TBD).
Remote Sensors	Monitor Remoted Sensor Packages.
Fire Direction Center	Control Firing Data Computation.
Remoted Target Designator	VCOS Interface.
Satellite Support	Voice, Data, Pos/Nav.
Special Communication, other	Commo-quantity or type.
Recon	High Power (Capability) Recon Pkg.
Smoke	Smoke Generation Assistance.
Maint/Repair Assist	Higher Echelon Support/Assistance.
Resupply, Refuel, Rearm	Manipulator Arm Control.
Medical Support	Combat Medical Support Tools.
Electronic Large Screen Display	Command Post (CP) Utilization.
Commo Master Station	House Special Commo Equipment.
IEW Support	Special IEW Support.
NATO Dictionary	Assist in NATO Interoperability.
Decision Support Modules	Tailored METT-T/OCOKA Tools, by Echelon.
Display, Keyboard Portable	Support Outside Vehicle Operation.
Small Screen Enlarger	Enlarge Small Screen to Large, at CP.
Facsimile	Paper Message Text, Transmission.
Audio/Visual Support	Commander's and Staff television.
Field Printer	Print Paper Copies.
Reproduction	Paper or Overlay Distribution.
Operation Support Assistance	TBD.
Robotic Combat Vehicle (RCV)	RCV Ground Vehicle Control.
Other, or Candidate P3I, TBD	TBD.

The VCOS architecture and the above listed mission support components support the B2C2 architecture. The B2C2 architecture follows on the next page.

Operational Definition for the AFV C3I Architecture

D. Battalion and Below Command and Control (B2C2) Architecture. B2C2 and VCOS are expected to be common AFV subsystems. B2C2 architecture is comprised of the six major components as listed below. The support objectives describe the type of tailored assistance envisioned for the battalion. Each component function summarizes the type of assistance to be provided to the chain of command and staff.



1) As stated earlier this is the most complex conceptual organization. It is a modular system, tailored to the chain of command. The system is supported by B2C2/ATCCS. The developed C2 system will be a standard within AFV. B2C2 will provide support for the basic tenets of battle: command, control, communications, mobility, survivability, maneuver, fire support, air defense, combat service support and intelligence. Survivability demands that all units plan for threat engagement.

Operational Definition for the AFV C3I Architecture

2) The next three charts summarize the component descriptions, chain of command distribution, and technical issues of B2C2. Together these charts portray the parts (or elements) of B2C2, provides a top level view of tailored battalion support, and functional C2 system interfaces with communication means.

3) B2C2 Component Descriptions. The six B2C2 components (page 3) are major classifications of required support. The parts or elements of these components described below.

B2C2 ELEMENT	TYPE OF SUPPORT OR ASSISTANCE	UTILIZATION/PRODUCT
OPERATIONS ORDER	•Staff Distributed Prep. Template by SOP.	•OPORD with Annex. OPORD Notification.
FRAGO	•Lower Echelon Extracts.	•Extract for Subordinates.
IMMEDIATE INFORMATION	•Quick Modification to OPORD.	•Warning/FRAG Order Message.
IMMEDIATE GUIDANCE	•For Cdr and Chain of Cmd. Info any subject.	•Request/Receipt for Information.
BATTLEFIELD GEOMETRY	•Prepare/Receive New Priority Guidance.	•Quick Message.
MISSION CAPABILITY	•Battle Graphics with boundaries/obstacles.	•Graphics displayed or projected, by unit/each, scheme of maneuver, OPORD portrayed.
OPERATIONAL STATUS	•Readiness status collected from operations.	•Commanders summary - critical path.
BATTLEFIELD LOCATION	•Staff data collection, detail.	•Functional area data collected.
IMMEDIATE CSS	•Functional area analytical tools.	•Detailed or Summary Reports.
NBC/DE ATTACK WARNING	•By echelon, unit/vehicle location.	•Unit or vehicle location displayed.
THREAT AIR WARNING	•Collect mission critical CSS, priority.	•Displayed and message prepared.
FIRE SUPPORT	•Known or projected threat alert.	•NBC strike warn or atk, Protection levels.
AD POSTURE	•Known or projected air threat notification.	•Air strike Warning or attack confirmed.
LOGISTICS STATUS	•All facets of fire planning and execution, and analytical tools.	•Recommended or required protection level.
PERSONNEL STATUS	•Command summary, (AD, MVR, CSS, IEW, FS).	•Complete fire plan and support assistance. (Air, naval, indirect, & direct fires).
ROUTINE PERSONNEL	•Data collection detail & analytical tools.	•Mission or functional area status.
ROUTINE LOGISTICS	•Data collection detail & analytical tools.	•Log/supply readiness and projections.
FS RESULTS	•Personnel actions and support.	•Soldier readiness, availability, & forecasts.
AD MISSION RESULTS	•Maintenance, Supply or Logistics action.	•Personnel request & support.
MAINT/NBC/DE POSTURE	•After action report.	•Supply Action/Request (all supply classes).
SHELL REPORT	•After action report.	•Kill/damage summary (or other mission area).
SITUATION	•Specific readiness levels, high priority.	•Kill/damage summary.
THREAT GRAPHICS	•Incoming fires.	•Information summaries.
ORDER OF BATTLE	•Situation changes enemy or friendly.	•Shell report.
TARGET INFORMATION	•Threat picture, graphics.	•Situation report - SITREP.
	•Threat who, what, where, when & why.	•Threat based on need or interest.
	•Priority target devel, & Analytical tools.	•Threat plan of attack, with Updates.
		•Tgt list summary auto/man feed to shooters.

Operational Definition for the AFV C3I Architecture

4) B2C2 Architecture, Chain of Command Function Distribution. This table presents the B2C2 envisioned distribution or utilization among the battalion staff and chain of command.

B2C2 Item	Content	Battalion Principal	Staff Action/ Interest	Subordinates on Commo Net ⁶
1	Operations Order	CDR	ALL	CO CDR ¹
2	Frago/Warning Order	CDR	S3	CO CDR ¹
3	Immediate Info	CDR	S3	CO CDR ¹
4	Immediate Guidance	CDR	S3	CO CDR ¹
5	Battle Geometry	S3	S2/S4/FSE	CO CDR ¹
6	Operational Status	S3	S1/S4	CO CDR ¹
7	Battlefield Locations/Obstacles	CDR	S3/S4/S2/FSE & ATTACH	CO/PLT/FIST
8	Mission Capability	CDR	S3	CO CDR ¹
9	FS Req/Response	FSE	S3/S2	FIST
10	ADA Warning	ADA OFF ³	S3/S2	ADA UNIT/CO
11	Immediate CSS	S1/S4	S3	CO/PLT/SQD
12	NBC/DE Attack	CDR/S3	S2	CO CDR ¹
13	ADA Msn Results	ADA OFF	S3/S2	ADA/CO
14	FS Results	FSE	S3/S2	FIST
15	Routine Log	S4	S3	CO/PLT/SQD
16	Log Status	S4	S3	CO/PLT/SQD
17	Routine Personnel	S1	S3/S4	CO/PLT/SQD
18	Personnel Status	S1	S3/S4	CO/PLT/SQD
19	ADA Status ²	ADA OFF	S3	ADA/CO
20	Maint Posture	S4	S3	CO/PLT/SQD
21	NBC/DE Posture	S3	S2	CO CDR
22	SITREP	S2	S3	CO/PLT/SQD
23	Shell Report	S3	S2/FSE	CO/PLT/SQD
24	Threat Graphics	S2	S3/FSE	CO/PLT
25	Target Info	FSE	S2/S3	CO CDR ¹
26	Order of Battle	S2	S3/FSE	CO CDR ¹
-	VCOS ⁴	XO	S3/BMO/ALL	NA

Key: 1= Co/Btry Commander and Platoon Leader have equivalent capability, the chain of command may turn capability on or off. 2= Critical Mission Area status, similar status from IEW, CSS, MVR and FS may be needed. 3= Officer/Staff responsible for Air Support/Defense matters. 4= VCOS houses the B2C2 interface component which logically contains 1 thru 26 above. 5= Battalion or top down view of network.

The summary that follows is a battalion top down description the type of support envisioned and interfaces that may be required for B2C2 analysis and development.

Operational Definition for the AFV C3I Architecture

B2C2 Architecture
Technical Interfaces and Requirements

B2C2 Item	Information Content	Type Communication Net	Tailored Battalion & Below Access	ATCCS Feeder Support
1	Operations Order	Voice	CO	MCS/ALL
2	Frage/Warning Order	Voice/Data	PLT	MCS
3	Immediate Info	Voice	PLT	MCS
4	Immediate Guidance	Voice	---	MCS
5	Battle Graphics	Data	PLT	MCS/ALL
6	Operational Status	Voice/Data	PLT	MCS/ALL
7	Battlefield Locations	Data	PLT/ATTACH	MCS/ALL
8	Mission Capability	Data/Voice	FIST/CO/PLT	MCS/ALL
9	FS Req/Response	Data/Voice	FIST/CO/PLT	AFATDS
10	ADA Warning	Data/Voice	All Elements	FAADC21
11	Immed CSS	Data/Voice	All Elements	CSSC2
12	NBC/DE Attack	Data/Voice	All Elements	MCS/ASAS
13	ADA Msn Results	Data	---	FAADC21
14	FS Results	Data	FIST/CO/PLT	AFATDS
15	Routine Log	Data	All Elements	CSSC2/ALL
16	Log Status	Data	All Elements	CSSC2/ALL
17	Routine Personnel	Data	All Elements	CSSC2
18	Personnel Status	Data	All Elements	CSSC2
19	ADA Status	Data	---	FAADC21
20	Maint Posture	Data	All Elements	CSSC2
21	NBC/DE Posture	Data/Voice	All Elements	MCS/ASAS
22	SITREP	Data	All Elements	ASAS
23	Shell Report	Data	All Elements	ASAS
24	Threat Graphics	Data	---	ASAS
25	Target Info	Data/Voice	SQD/ATTACH	ASAS
26	Order of Battle	Data	---	ASAS
-	VCOS, B2C2 Support	Internal, Vehicle	All Vehicles	ALL

E. Architecture Interoperability. Interoperability is viewed from two perspectives: VCOS C2 Support and B2C2-VCOS support.

1) VCOS C2 Support. The table below describes the interoperability support between the VCOS and C2 system from a functional viewpoint. This table provides a description of how the AFV VCOS could assist in unit command and control.

<u>VCOS Functional Component</u>	<u>Candidate VCOS Support of Command and Control</u>
Embedded Training	Provide communication system and unit C2 training. Wartime essential assistance for new or untrained personnel.
Intercom	Internal crew communications. Interconnect with communication module for external communications. Plan for voice activated VCOS-B2C2 commands
Fighting Station	Integrated cockpit with integration and control assistance. Provides more time to plan-execute unit command and control. Minimize manual effort.
Continuous Power	24-72 hour continuous operations. Mission critical modules receive power priority.
Automotive Management	Feeds CSS module with automotive status.
Environment Control	Assists in unit supply and logistic operations. Helps soldier survive NBC and Fire. Removes outside environment extremes (hot-cold, humidity) from inside vehicle.
Mission Support	Integrate the myriad of C2 support tools available. (page 8)
VCOS Control	Controls functional information flows with the vehicle. Ensures that graceful degradation occurs. METT-T support for soldier.
Vehicle Defense	Survivability assistance. Decision support assistance. Assist C2 swiftly determine unit threat engagement status.
External Port	Unit local area communication network interface and interconnection. Port for external TMDE or training device receptacle for outside to inside vehicle communications.
Tgt Acq-Recog (TAR)	SITREP development.
Multiple Bus	Information distribution, optimize soldier efficiency within the system - in the vehicle.
Fire & Weapon Control	Ammunition status to CSS module. Planned or actual engagement may be reported (manual, semi or fully automatic).
Position-Navigation	Assist in vehicle or unit location determination. Terrain and time available support analysis may be available. Location stamp on external messages.
Communications	External communication to feed needed information to the chain of command or for lateral coordination. Prioritized or queued voice or data message flows. Reduced time on voice radio. Date-time stamp on message for accuracy-validity check. A provided voice record mode means voice messages not missed.
Combat Service Support ...	Expedite unit CSS.

Operational Definition for the AFV C3I Architecture

2) B2C2-VCOS Support. Common B2C2 support from VCOS is provided by embedded training, data bus, continuous power, mission support, communication, and fighting station functional components. The table below describes the B2C2 system and the envisioned VCOS support. It summarizes the the type of support provided to the C2 function from a C2 viewpoint.

(a) Training. May provide assistance for special missions, e.g. river crossings, passage of lines, allied operations in peace and war modes.

(b) Data Bus. Assists in information distribution in and around the vehicle. Reduces soldier workload by reducing soldier information input (entry) into the unit command and control system.

(c) Continuous Power. Maintains critical power to C3 support systems. Takes power away from non-critical components not in use.

(d) Mission Support. Candidate mission support functional modules such as, datafax, multiple copy preparation, or UAV interfaces may interact with the C2 system.

(e) Communication. Vehicle internal and external communication transmit information where and when it is needed. CEOI assistance save the soldier time. A NATO dictionary may assist interoperability at selected portions of the chain of command by providing automatic data transmitted translations. The communication module may also assist the soldier determine the best communications means.

(f) Fighting Stations. Integrated displays and controls for the soldier provides the needed system support. It displays appropriate vehicle resident information and allows component control or operation from this battle position.

<u>B2C2 Functional Component</u>	<u>Possible VCOS Support Area</u>
Operations Order	Preparation and dissemination mission support assistance.
Frage/Warning Order	Preparation and dissemination of unit level order.
Immediate Info	Top down or chain of command highest priority text message voice or data.
Immediate Guidance	Chain of command high priority message support.
Battle Graphics	Unit locations displayed voice or data. Software takes unit center of mass and depicts battlefield topography. Rapid change of map scales or orientation. VCOS Pos-Nav module may show vehicle relationship to battlefield.

Operational Definition for the AFV C3I Architecture

<u>B2C2 Functional Component</u>	<u>Possible VCOS Support Area</u>
Operational Status	Mission status portrayed: in battle, preparing for battle, or recovering from battle.
Battlefield Locations ..	Chain of command location updates. Position navigation provides individual data.
Mission Capability	Readiness determination based on cdrs rules. Controller maintains known vehicle status.
FS Request-Response	Call for fire templates. Communication module finds an open commo net to transfer information.
ADA Warning	Audible-pictorial notification. Emergency notification may place fire and weapon and TAR module in air attack combat mode.
Immediate CSS	Audible-pictorial notification. CSS identifies known LRU item. Communication support integrated. Ammunition inventory received from fire control functional module. Automotive module knows the fluid and fuel levels. CSS prognostic rules may forecast critical vehicle problem.
NBC/DE Attack	Audible-pictorial notification. Automatic or semi-automatic NBC protection enabled.
ADA Mission Results	Prioritized data communication.
FS Support results	Call for support known, therefore only results are broadcasted. Prioritized data communications.
Routine Logistics	Prioritized or queued messages. CSS modules assists in repair part forecasted or actual needs.
Personnel Status	Prioritized messages. Environment module detects (sleep-awake) lighting conditions. CSS module knows assigned personnel from training module.
ADA status	Weapon position and status (free, hold) from fire control. Vehicle equipped TAR may support as well.
Maint Posture	CSS module report. Supply-Log status.
NBC/DE posture	Environment control system status. VCOS knows if NBC protection turned on or off.
SITREP	Provide vehicle resident information.
Shell Report	Vehicle defense sensors may assist reporting, minimizing soldier exposure to battlefield.
Threat Graphics	Display slice of Threat to unit. Drawn picture assists RSTA-Intel reporting by transforming picture to SITREP.
Target Information	Combine TAR and fire control information.
Order of Battle	Preparation of information from resident data base (if applicable to echelon). Provide software to correlate SITREPS.

Operational Definition for the AFV C3I Architecture

3) Architecture Definition Challenge. The individual definitions of B2C2 and VCOS coupled with the interoperability aspects of each have initially defined how the VCOS and B2C2 systems are envisioned to provide mutual support.

E. C3I Architecture Closing Remarks. This concludes the architecture summary descriptions of B2C2 and VCOS. When combined these form the AFV C3I architecture. It is characterized by mutual supporting integration. VCOS provides maximum support for the soldier to reduce his C3I and vehicle workloads by capturing, retaining, and organizing already available information. B2C2 as tailored to the chain of command and supported by VCOS, provides the battalion and lower echelons a command and control tool for combat. A candidate development scheme is presented next.

7. DEVELOPMENT SCHEMA.

A. Background Discussion.

1) The Vehicle Control and Operating System (VCOS) has its roots in the Armor School supported Inter-Vehicle Information System (IVIS), the ARDEC Fire Control/Battle Management (FC/BM), and the TACOM Vetronics (Vehicle Electronics) programs. IVIS is under development for an Abrams tank (Block Two) improvement. Both FC/BM and IVIS are designed to assist the tank commander execute his vehicle and C2 (command and control) responsibilities. Vetronics is a bus or local area network which connects a to be determined number of vehicle components to facilitate information integration within the vehicle. A contract to develop the Army Vetronics interface and interconnect standard is planned for award this year. It will only define how to pass information and power around the vehicle. The contract does not specify the number or level of functional component interfaces. This summary starts to define what and eventually when information is to be distributed.

2) Battalion and Below Command and Control (B2C2) has its roots in the force level control system (FLCS) within the Army Tactical Command and Control (ATCCS) and Maneuver Control System (MCS) - IVIS concepts. FLCS provides the interface for each battlefield functional area above battalion and provides the capability for horizontal information sharing. FLCS is planned for common functional area use. Vertical mission area focus is dominant at lower echelons. ATCCS refinements or improvements are constrained by the current or near term product improved combat fleet. This requires "add on" integration or additional equipment to achieve an ALB or ALB-F required capability. Strengthened by ALB-F concepts, B2C2 attempts to provide the vertical and horizontal information flows for the future battalion force, based on common "mutually supporting" vehicle-C3I integration.

Operational Definition for the AFV C3I Architecture

3) MCS-IVIS has recently (FY87) been incorporated as a module in the [TACOM] Combat Vehicle Command and Control (CVCC) Program. The current thrust of CVCC program aside from joint US and German interoperability is to develop an Armor command and control system for battalion and below. It encompasses the salient characteristics of IVIS, FC/BM and Vetronics. A candidate CVCC fielding is the M1-Abrams tank or maybe the M2-Bradley infantry vehicle.

4) IVIS, FC/BM, (CVCC,) and Vetronics have demonstrated their growth potential for the tank. The concepts established by these programs have also found potential applications in the howitzer improvement program and elevated target acquisition system among others; however, the need for further definition remains. VCOS and B2C2 require definition for AFV -- as a family and as a force.

5) The current CVCC [IVIS and Vetronics] focus on single user or mission area requirements development is not sufficient. Battalion command and control concepts established by MCS-IVIS (formerly BMS) and ATCCS must be refined for an AFV battlefield environment -- ALB Future.

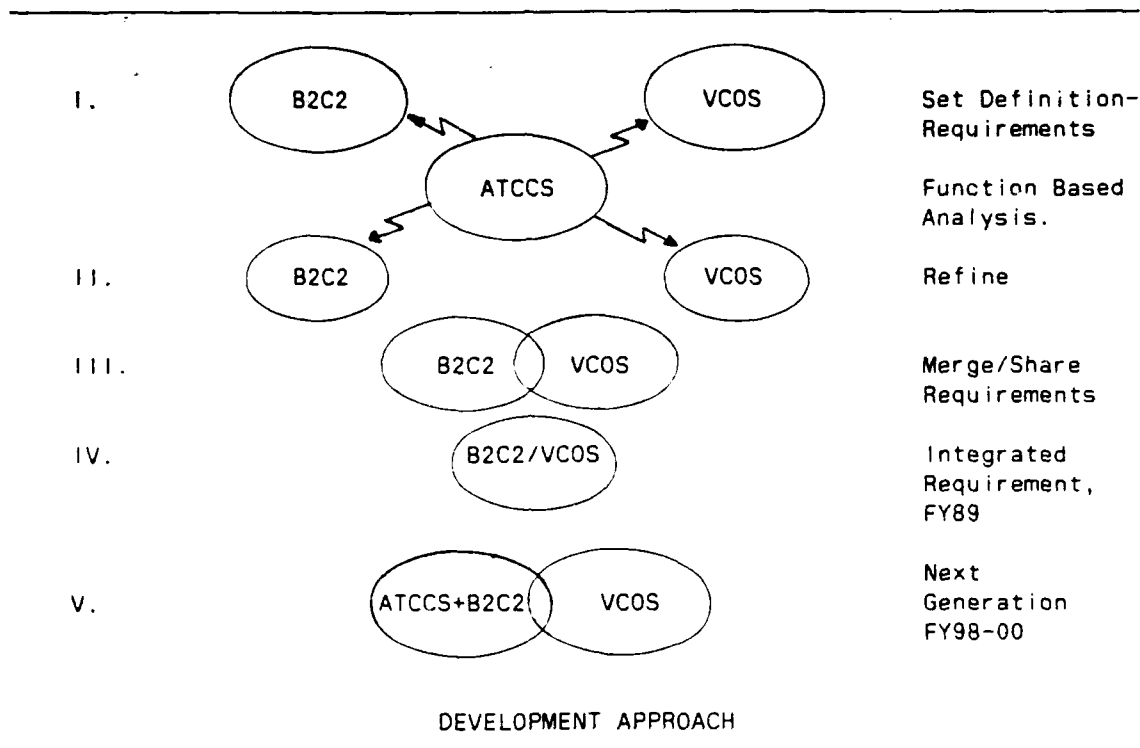
6) The skeleton set of requirements provided within this document are the start for this refinement effort. The designation of VCOS components, levels of interfaces, and their respective functionality must be defined in terms of force level AFV. B2C2 is envisioned to support ALB-F and provide the needed horizontal and vertical interface and support at battalion and below levels.

B. Development.

1) The recommended approach is to develop the VCOS and B2C2 requirements separately. VCOS will concentrate on fighting the vehicle; B2C2 will develop the C3I requirements for the battalion. Separating the development effort is desired due to the magnitude and complexity of effort. The Army has already demonstrated that individual vehicle and mission area pure C3I requirements can be developed. It has also demonstrated that multiple mission area concepts such as this, are difficult to develop and refine. The difficulty is not the implementing technology but the need to gain consensus.

Operational Definition for the AFV C3I Architecture

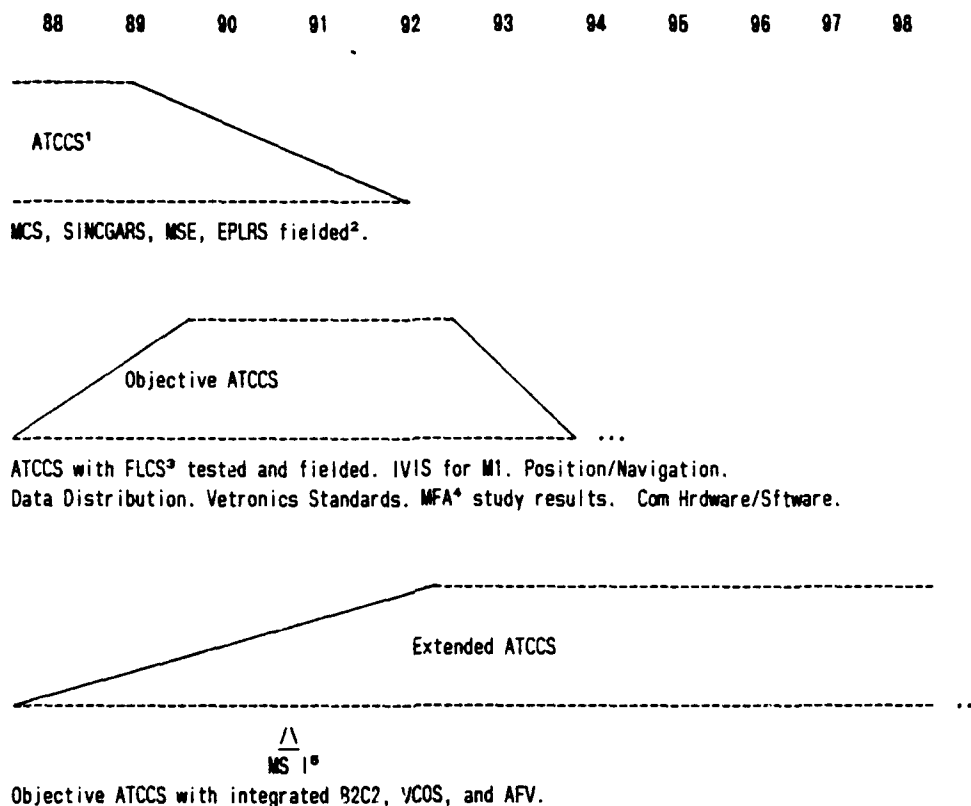
B. Development (continued).



2) Future analysis and decisions will determine the best vehicle and C3I functional and technical materiel mix to the support battalion forces. AFV presents the opportunity to provide common squad through battalion C3I and vehicle control system. AFV C3I does not conflict with ATCCS and will not supercede ATCCS functional requirements within each mission area. It is complementary. AFV C3I adds common warfight planning and assistance to ensure interoperability among task organized forces. The figure below describes the relationship of B2C2 and VCOS to the ATCCS materiel acquisition process.

Operational Definition for the AFV C3I Architecture

ATCCS Materiel Acquisition Process



Acronym Key:

- ¹: Army Tactical Command and Control System (comprised of Maneuver, Air Defense, Combat Service Support, Intelligence, and Fire Support C2/C3I functional and communications systems).
- ²: Maneuver Control System, Mobile Subscriber Equipment, Single Channel Ground Airborne Radio System, Enhanced Position Location Reporting System.
- ³: Force Level Control System (allows mission area C2 system interface).
- ⁴: TRADOC Maneuver Functional Area Tactical Automation Study, Dec 87.
- ⁵: AFV C3I Architecture is refined through Demonstration Validation.

2) Initial separation of VCOS and B2C2 allows the critical issues to be raised and refinements made concurrently without premature vehicle versus C3I trade off. Once the user communities agree on a basic set of functional requirements for VCOS and B2C2 then these requirements can be refined, merged, and finally targeted for materiel solutions.

Operational Definition for the AFV C3I Architecture

3) Bottom line - Instrumental in the development and concepts analysis processes is the need for AFV C3I to be defined. Execution of this critical task is crucial to the entire development program. Action now supports the probability of:

- Reduced risk of missing AFV decision points,
- Improved combat-materiel engineering of C3I into AFV,
- Increased available time to achieve
 - Planning for future, not reacting
 - Concept specificity, not generalization
 - Requirements agreement based on satisfaction, not pacification
 - Analysis based on requirements, not intuition
 - Specific C3I cost and resource analysis, not chassis only
 - Post deployment long term support planning, not short term only
- Reduced testing (and prototyping) due to a complete definition,
- Synchronized ATCCS integration and software/hardware development,
- Decreased dependence on contractor concepts and implementations,
- Reduced overall system engineering complexity, or
- Achievement of integrated or mutually supporting vehicle & C3I systems.

8. CLOSING REMARKS. B2C2 and VCOS summaries propose an initial set of requirements for battalion and below C3I and vehicle control. AFV must have a VCOS or VCOS like system to orchestrate vehicle functions to best support the soldier. The basic premise of AFV C3I is that given a VCOS, integrated B2C2 can be achieved that is characterized by maximum commonality, modularity, and interoperability. Doctrine and the dynamics of battle demand synchronization of all forces. The Army must continue to explore the AFV advantage in all combat areas: lethality, survivability, mobility, combat support, and C3I.

-
- oo WHAT ADVANCES IN C3I CAN BE ACHIEVED BASED ON A NEW ARMORED FORCE ?
 - oo WILL AN INTEGRATED VEHICLE CONTROL SYSTEM PROVIDE IMPROVED C3I SUPPORT ?
 - oo WHAT CAN BE DONE TO REDUCE SOLDIER WORKLOADS WITH TIME SAVED ?

AFV Concept Exploration and Definition Phase Issues for Resolution

Operational Definition for the AFV C3I Architecture

9. POINTS OF CONTACT. Major Jones (TRADOC AFV Proponency Office) AV 552-3715, Mr. Gene Dudley (CACDA, C3I) AV 552-4786, Captain Mingilton or Major Moore (AMC AFV Integration Group) AV 284-1965, Major Buckstad or Major Wooster (AFV Task Force, CD) AV 927-1465.

VCOS - FIGHT THE VEHICLE ... Help the Soldier
B2C2 - FIGHT THE FORCE ... Assist the Chain of Command
ATCCS - FIGHT AND SUPPORT THE FORCE ... Mission Area Support & Control

The Goal
